UNITED STATES PATENT OFFICE.

GEORGE B. GRANT, OF LEXINGTON, MASSACHUSETTS.

MACHINE FOR PLANING GEAR-TEETH.

SPECIFICATION forming part of Letters Patent No. 407,437, dated July 23, 1889.

Application filed January 14, 1887. Serial No. 224,382. (No model.)

To all whom it may concern:

Be it known that I, GEORGE B. GRANT, of Lexington, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Machines for Planing the Teeth of Gear-Wheels, of which the following is a specification.

This machine is designed to plane the working-surfaces of the teeth of bevel or spur gears to the theoretically correct form of either the epicycloidal or involute shape. It does not plane the teeth to a copy of a templet which has previously been brought as nearly as may be to the correct form, as usual with machines for the same purpose, but it originates the tooth curve according to its mathematical theory, and will plane it as nearly true as the perfection of the parts of the machine will permit.

Figure 1 is a plan of the whole machine. Fig. 2 is a side elevation from the position 45 of Fig. 1. Fig. 3 illustrates the mathematical principle upon which the operation of the machine is based. Fig. 4 shows the operation of the cutting-tool in several positions.

The principle of the operation of the machine is shown in outline by the diagram Fig. 3, in which the pitch cone of the gear to be planed is represented by 2. If a small cone 3 is rolled on the pitch cone, their apices coinciding at the point 1, any element 5 of the rolling cone will sweep up an epicycloidal surface 7 on the pitch cone, which is suitable for the working-face of a gear-tooth. Similarly, if a small cone 4 be rolled on the inside of the pitch cone, any element 6 will sweep up a hypocycloidal surface 8, which is suitable for the flank of a gear-tooth. The machine is designed to carry this principle into practical operation, and its method is to reciprocate a planing-tool in an element of a cone that is rolled on the pitch cone of the gear being cut. It is most convenient to use a rolling cone with a circular base; but there are many curves that would act as its base without altering the principle of its operation. When the rolling cone is increased in size until its center angle is ninety degrees, it becomes a plane circle. Its element will form an epicycloidal surface as before; but it is now called an "involute" surface. The involute surface is a special case of the epicycloidal surface, differing from it principally in the valuable feature that it will allow a variation in the center distance of the shafts of spur-gears, or in the angle between the shafts of bevel-gears, without affecting the uniformity of the motion transmitted.

In the figures, the gear-blank 19 is held by a gear-spindle 20, that is supported by the frame 25 and oscillated by the index-wheel 21. The index-wheel receives a slow feeding motion by means of the pinion 22.

The carriage 44 is adjustable on the frame 25 in two different directions at right angles, or nearly so, to each other. It can be moved against the guide 29 in a direction parallel with the center line 15 1 of the gear-spindle, and it can also be moved against the guide 28 at right angles to that center line. The carriage can be fastened in any position on the part 26 or the part 27 of the frame.

The stand 34 is carried by the carriage 44, and can be angularly adjusted by turning it on that carriage about a vertical axis through the point 1 in the center line 15 1, and be fastened in any angular position by means of bolts 9, which hold in circular T-slots in the carriage 44.

The tool-shaft 65, which represents the axis of the rolling cone, is held by the stand 34 with its axis perpendicular to the axis of the stand and passing through the center point 1. This tool-shaft axis 33 1 can thus be placed in line with the axis 15 1 of the gear-spindle, or set at any angle with it on either side of it and there fastened.

The tool-guide 38 represents the element of the rolling cone. It is adjustably fixed on the plate 35, which is attached to the tool-shaft 65 and turns with that shaft. It is angularly adjustable on the plate 35, so that it can be set at any desired angle with the axis 33 1 of the tool-shaft about the point 1 as a center. It is also laterally adjustable upon the plate 35, so that it can be set parallel to the axis of the tool-shaft at any desired distance from it by means of the scale 36. The tool-guide 38 rests upon the plate 35, and is fastened upon it by bolts 10, which hold in T-slots in it. When the tool-guide is to be either angularly or laterally adjusted on the